Hazardous Exhaust – Discharge Options

Presented by: Bruce E. Appel, P.E.

Principal

Cator, Ruma & Associates, Co.

Mech./Elec. Consulting Engineers

1550 Dover Street, Suite Two

Lakewood, CO 80215-3132

303/232-6200

Introduction

- This Presentation is Oriented Toward Larger Laboratories, Manifolded Systems.
- Review Design Criteria for Fume/ Hazardous Exhaust.
- Discuss Design Challenges.
- Discuss Design Tools for Mitigating the Fume Hazards to Maintenance Personnel and Building Occupants.
- Discuss Design Solutions We Have Used Successfully.

Factors Affecting the Proper Discharge of Hazardous Exhaust

- Stack/Intake Separation.
- Stack Height.
- Stack Height Plus Momentum.
- Momentum =
  Density x Volumetric Flow x Velocity

  Due to Architectural Limitations, the Plume Momentum is often the Design Parameter Within the Engineer's Control.

Design Criteria

- Stack Height Minimums.

  NFPA 45 – 10 feet above roof

  AIHA Standard Z9.5 – 10 feet above roof

- Stack Exit Velocities.

  ASHRAE (2001, Chapter 44) –

  2,000 fpm to 4,000 fpm

  AIHA Standard Z9.5 – 3,000 fpm (min.)

- Minimum Separation Distance.

  1997 Uniform Mechanical Code (UMC) – 10 feet between outlet and intake (unless 3 feet above intake).

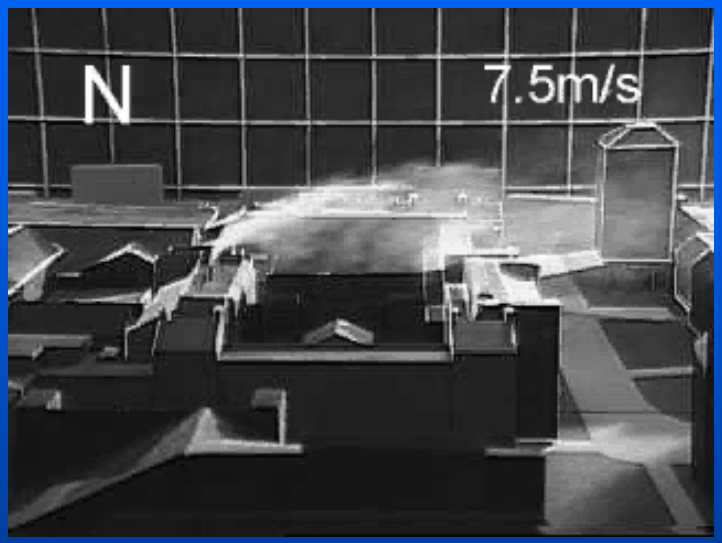
Design Challenge

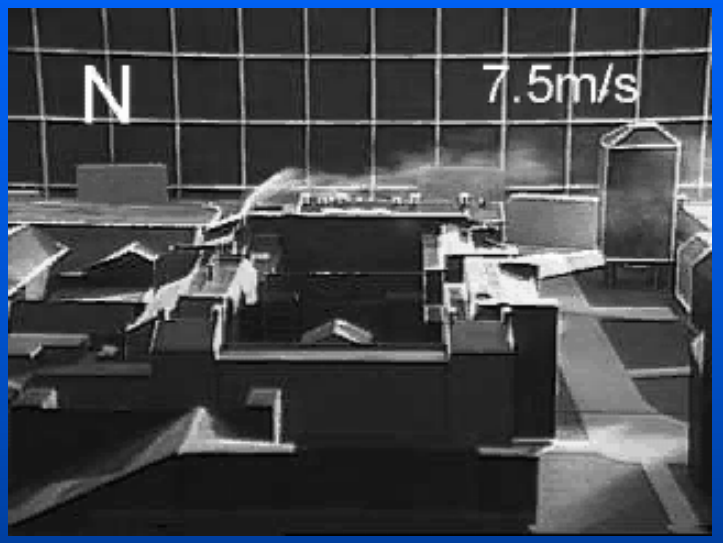
- Maintain Adequate Discharge Velocity with Variable Flow Exhaust.

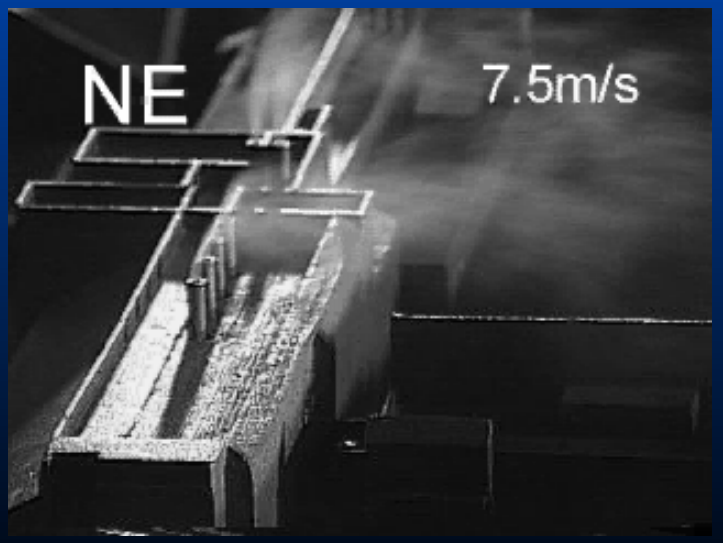
Design Tools Available

- ASHRAE Handbook – Chapter 16, 2001 Handbook and Chapter 44 of 2003 Handbook.
- Wind Study
  - Computer Modeling
  - Built-Up Model

CU Porter Biosciences – Wind Study







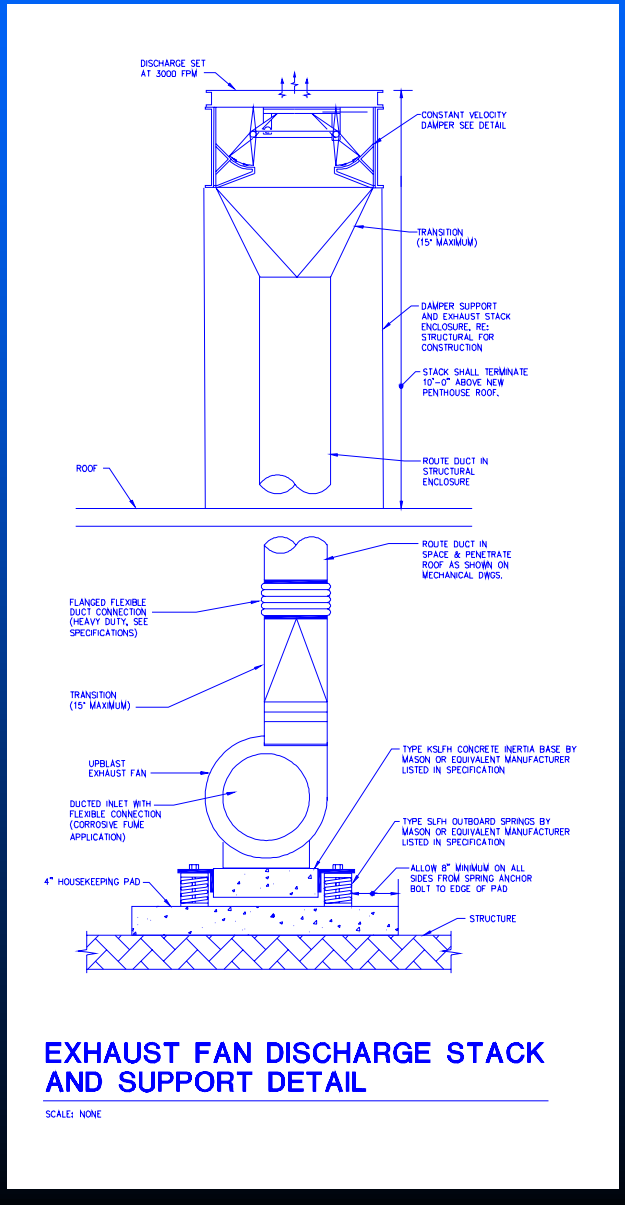
Exhaust Discharge – Variable Flow Design/Constant Discharge

- Option #1 – Bypass at the Fan Inlet
  - Design Considerations
    - » Extra Fan Energy at Part Load
    - » Good Dilution of Effluent
    - » Higher Momentum of Plume
    - » Fan Costs

Exhaust Discharge – Variable Flow Design/Variable Discharge

- Option #2 – Discharge Damper at the Stack
  - Design Considerations
    - » Fan Savings at Part Load
    - » Less Momentum
    - » Damper is Large (Requires Structural Support)
    - » Requires Damper Control

Exhaust Fan Discharge Damper



University of Colorado – Porter Biosciences MCDB Laboratory

CU Porter Biosciences – Fan Discharge Dampers

Energy Savings and Payback

- 40 HP Motor Operating at 70% of Full Load Saves 172,000 kwh/year
- At $0.05/kw, Annual Savings are $8,600/year Compared to a Bypass Fan

Summary

- Design Criteria was Reviewed
- Exhaust Discharge Design Options
- Advantages/Disadvantages of Each Were Reviewed